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NCEL Techdata Sheet

Photovoltaic - Powered Security Lights Cut Energy System Costs

Harnessing sunshine to generate electricity for security lights on AA&E bunkers at U.S. DOD facilities can reduce system costs by 50%. In 1985, 30 photovoltaic-powered security light systems were installed at Navy facilities in California, New Mexico, and Maine.

In 1982 the Department of Defense issued regulations that all arms, ammunition and explosive (AA&E) bunkers should be lighted. Since the bunkers are located in remote areas, the cost of installing utility grids to the bunker site was prohibitive in most cases. Research in the use of photovoltaic (solar) cells to provide the necessary power was undertaken by the Naval Civil Engineering Laboratory (NCEL). The capital cost savings for using reliable photovoltaic (PV) power can be a factor of 2 over using more conventional power sources.

Each lighting system consists of three subsystems: (1) the photovoltaic array power source, (2) battery storage with regulator, and (3) lamp. The PV array generates DC electricity during daylight hours (some power is generated even in cloudy weather). This power is provided to the battery storage subsystem any time the battery is less than fully charged. The regulator adjusts the power flow from the PV array and to the lamp after the sun goes down. The lamp used for the 30 systems installed during 1985 was a 13-watt fluorescent lamp with a 12-VDC ballast. The systems were installed in widely diverse areas of the United States (NWS Fallbrook, Calif.; NAS Brunswick, Maine; and NOMTC White Sands, N.M.) to gain operational experience under varying climate and environmental conditions. Availability of sunshine varies widely from region to region. However, there are no regions, including Antarctica, where PV is not now being used to provide reliable electric power.

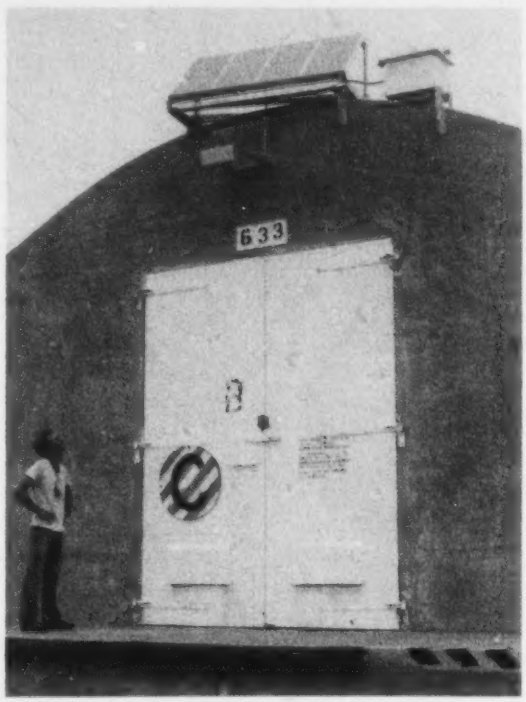

Figure 1. PV powered security light installed at NWS Fallbrook, California.

Designing a PV power system requires consideration of the solar resource, the electrical demand, and the likelihood of

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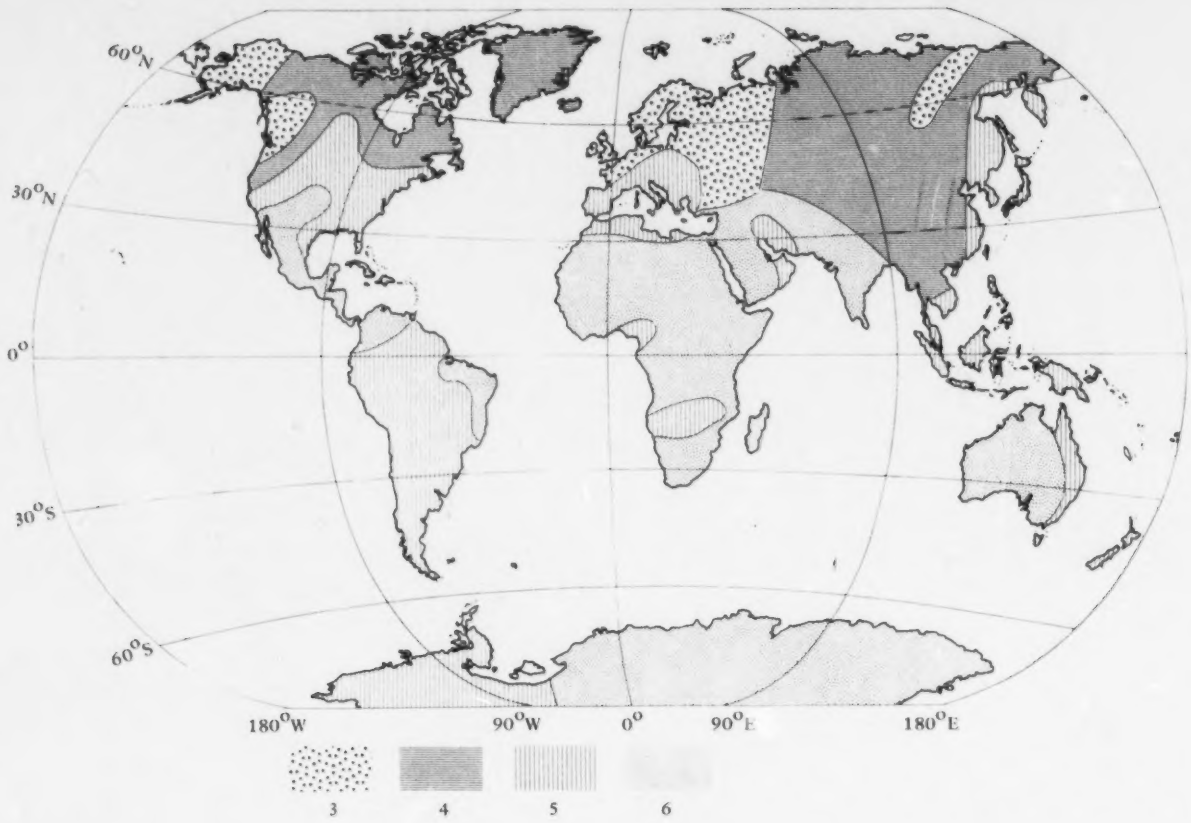

Figure 2. Photovoltaic power available - kilowatt-hours per day.

successive cloudy days. Optimum designs require specific information for each of these parameters. However, many successful and cost-effective designs can be developed using general guidelines. Figure 2 gives the projected daily energy output, in kilowatt-hours, of a 1-kW "rated" PV array located anywhere in the world. Specific long-term weather data from over 1,100 sites were used to generate the map. If the electrical demand is known, the amount of PV power necessary can be easily calculated. Add battery storage and a lamp and the result is a reliable security light system that can be installed anywhere.

To date, operational experience with photovoltaic lighting systems has been good. The 30 systems installed during 1985 have performed flawlessly for several months. System development tests on prototype systems at NCEL have shown that the concept is sound for a number of illumination schemes with the fluorescent lamp being most adaptable in terms of durability and tolerance of ambient conditions.

O&M concerns for photovoltaic lighting systems address maintaining electrolyte levels and assuring that the voltage regulator is working. System failures can be easily resolved through standard circuit check out procedures.

NCEL CONTACT

G.H. Watson, Code L73; tel: Comm (805) 982-4207, A/V 360-4207, FTS 799-4207.